

## USMS Measurement Needs Authentication Guidance

Feb 17, 2006

**Background:** NIST is producing an assessment of the United States Measurement System (USMS), due to be published in June of 2006. The general premise for the USMS is:

- Most of U.S. industry's most critical needs in measurements are linked to technological innovation.
- These measurement needs arise from measurement problems associated with the creation, production, marketing, and effective use of new product and process technologies.
- It is a primary function of the U.S. measurement system to deliver measurements that meet U.S. industry's measurement needs.

It follows that an assessment of the state of the USMS can then begin with a broad survey of industry measurement needs relative to technological innovation. From the results of this survey, inferences may be drawn about the overall state of health of the USMS and an assessment made. Documentation of measurement needs within the U.S. Measurement System Assessment program is achieved using the Measurement Needs Datum template to provide a single page, fixed format description. These documents contain assertions concerning the facts surrounding a particular measurement issue that poses a real or potential problem or impediment to technological innovation. Authentication is confirmation that the information contained in the Measurements Needs document is a factual and accurate summary of the subject matter. Several means are available for authentication of Measurement Needs.

**Guidance** Thank you for participating in this important assessment through drafting a Measurement Need. The next step after the Measurement Need has been accepted is for the Author or Submitter of the Measurement Need to collect the authentication material and to write a paragraph or two that describe how that material validates the assertions made in the Measurement Needs document. To aid you in collecting the authentication material, examples have been included.

The next page is the checklist that authentication material will be reviewed against. [Cameron: Need to add this to the document.

Exhibit 1 - discusses and summarizes the public domain, documentary references used in developing the Measurement Needs (MN) document, specifically referring to key facts and major assertions that are presented in various sections. The use of publicly available documents that support key facts or major assertions is critical to supporting the information in the MN. A pdf copy of the relevant pages in the referenced documents would be helpful but not necessary. However, a specific quote from the document should be included if the pdf copy is not available. The USMS Task Group expects that authentication of many MNs will in part rely upon such an authentication description.

Exhibit 2, 3, 4, and 5 – Shown are 4 examples of the 5 methods used to authenticate the Measurement Need. The example shown here is overkill. Typically, a complete representation of one of the basis is adequate to authenticate the Measurement Need. Please refer to the checklist for the basis characterization required. A cover page is required to explain the pertinent details of the basis. A pdf copy of the relevant words in the documents or letters would be helpful but not necessary. However, a specific quote from the document should be included if the pdf copy is not available.

Exhibit 2 – Workshops. A workshop whether USMS facilitated or not can authenticate a Measurement Need as long as it represents a significant fraction of the industry. The only requirement here is that the results of the workshop are documented and in the public domain.

Exhibit 3 – Technology Roadmap. A technology roadmap can authenticate a Measurement Need as long as it represents a significant fraction of the industry, is relatively recent in time, and is a publically available document.

Exhibit 4 – Industrial Representative. Statements made by industrial representative of an organization such as a trade organization that represents a significant fraction of the industry can authenticate a Measurement Need. A copy of the statements, documents, should be included if a written copy was

## **MN Authentication Summary**

provided to the submitter. If the statements were taken during a phone conversation or through email, the guidance sheet in the 'kit' should be included.

Exhibit 5 – Individual Point of View. Statements made by a collection of individuals that represent a significant fraction of the industry can authenticate a Measurement Need. A copy of the statements should be included if a written copy was provided to the submitter. If the statements were taken during a phone conversation or through email, the guidance sheet in the 'kit' should be included.

# USMS Measurement Needs Authentication Guidance

Feb 17, 2006

Purpose: For use by members of NIST USMS Task Group on MN review panels as a common basis for deciding the acceptability of the authentication of an MN

Indicate in blank space after item ✓ if OK or YES or ✗ if Not OK or NO or N/A if Not Applicable

MN Title and/or ID Number \_\_\_\_\_

<b>Format</b>	One single file in electronic form _____	
<b>Documentary References</b>	Specific references for documentary sources, calling out evidence for the key facts and major assertions are presented in each section	
	Technological Innovation _____	Economic Significance _____
	Barrier to Innovation _____	Measurement Problem _____
	Potential Solutions _____	Solution Providers _____
	Role for government _____	
<b>Basis for Authentication</b>	What are the primary authentication methods?	
	Public documents _____	Workshop _____
	Published roadmap _____	Industrial representative _____
	Individual point of views _____	
<b>Public Documents</b>	<i>For each authentication method complete the following sections.</i>	
	Are the public documents (technical assessment reports, government reports, policy assessment, economic studies, etc.) referenced properly? _____	
	Are the relevant quotes from the documents stated? _____	
	Do the public documents represent a large fraction of the community? _____	
<b>Workshop</b>	Does this method externally authenticate the MN sufficiently by itself? _____	
	Is stated workshop facilitated by USMS? _____	
	Is the workshop information provided? (Topic/Date/Location/Purpose) _____	
	Is the audience characterized? (industry/academia/govt? participant list?) _____	
	Is the reference information for presentations and/or proceedings stated? _____	
	Does this method authenticate the MN sufficiently? _____	
<b>Published Roadmap</b>	Is the roadmap information (Topic/Date/Location/Purpose) stated? _____	
	Is the developer characterized? (industry/academia/govt? participant list?) _____	
	Are the relevant quotes from the roadmapping documents stated? _____	
	Is the assessment a recent representation of the industry? _____	
	Does this method externally authenticate the MN by itself sufficiently? _____	
<b>Industrial Representative</b>	Is the names/affiliations/titles/contact information stated? (Trade Association) _____	
	Is the characterization of the group they represented stated? _____	
	Does this method externally authenticate the MN by itself sufficiently? _____	
<b>Individual Point of View</b>	Is the names/affiliations/titles/contact information stated? _____	
	What is the documentation of the individual point of view _____	
	Letter to the USMS Director _____	General letter to NIST _____
	Authentication questionnaire – email _____	phone conversation _____
	Do the total responses represent a significant fraction of the industry? _____	
	Does this method externally authenticate the MN by itself? _____	
<b>Authentication Material</b>	Balanced: Are the sources balanced in their assessment of the information? _____	
	Informed: Are the sources credentialed and have extensive knowledge? _____	
	Representative: Does the authentication material represent the community? _____	
<b>Bottom-Line</b>	MN Authenticated: Accepted _____ Requires additional material _____	
	Deficiencies: _____	

## Exhibit 1

**Technology at Issue:** Airborne Contamination in Semiconductor Wafer Processing

**Submitter:** J. T. Hodges, NIST

**Authentication Information Provider:** J. T. Hodges, NIST

**Date:** 2/16/2006

Measurement needs and technical challenges for AMC in semiconductor wafer processing spanning the next 15 years are given in the International Technology Roadmap for Semiconductors (ITRS), <http://www.itrs.net/Common/2005ITRS/Home2005.htm>. Sponsored by the SEMATECH consortium, the ITRS is a broad technology assessment cooperatively developed by industrial manufacturers and suppliers, government and academic organizations. A key measure of technological progress defined in the ITRS is yield enhancement (YE) which is the process of improving baseline yield for a given technology generation from R&D yield level to mature yield. AMC affects YE and constitutes a major impediment to wafer environment contamination control particularly for 300 mm wafer manufacturing processes. An industry expert, G. Dan Hutcheson of VLSI Research Inc., estimates that “a 1 % yield increase equates to \$1M per day additional profits for a modern 300 mm fabrication line,” *The Chip Insider*®. The ITRS also states “The impact of AMC on wafer processing can only be expected to become more deleterious as device dimensions decrease. There is a need for better AMC monitoring instrumentation ... to measure AMC at the part per trillion level ... low cost, routine monitoring may be required as devices approach molecular dimensions.” Target impurity levels relevant to wafer environmental contamination control for a number of AMC including H<sub>2</sub>O, THC, CO<sub>2</sub> and other AMCs in various bulk gases are given in ITRS Table 115 and quantify the measurement needs in a variety of wafer production processes. Similarly, the Semiconductor Equipment Manufacturers International (SEMI) has standards describing the production and delivery and value assignment of ultra-high purity gases for semiconductor manufacturing. See <http://downloads.semi.org/PUBS/SEMIPUBS.NSF/webstandardsgases>. These standards illustrate the stringent requirements for gas purity measurements in semiconductor processes.

With regard to the production of nanomaterials having applications that go beyond traditional semiconductor technology, efficient manufacturing methods require unprecedented levels of material purity and quality control. Long-term metrology needs for monitoring and control of contaminants in process gases used in the manufacture of nanomaterials are given high priority in the *Chemical Industry R&D Roadmap for Nanomaterials by Design: From Fundamentals to Function*. See [http://www.chemicalvision2020.org/pdfs/nano\\_roadmap.pdf](http://www.chemicalvision2020.org/pdfs/nano_roadmap.pdf).

## Exhibit 2

### Basis for Authentication

#### *Workshop:*

Two workshops have been held in the past years by the Lighting Research and Development, Building Technologies Program, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy and National Renewable Energy Laboratory. These workshops were not facilitated by the USMS effort. The workshop information is provided below:

Solid-State Lighting Program Planning Workshop Report, February 3-4, 2005 - San Diego, California

Illuminating the challenges SSL Program Planning Workshop Report, November 13-14, 2003 - Crystal City, Virginia.

The workshop provided an interactive forum for shaping and prioritizing DOE's SSL research and development activities. Participants reviewed, discussed, and prioritized more than 65 R&D tasks and subtasks within the DOE SSL R&D agenda. The audience attending the workshop is attached to this document along with relevant quotes from the published workshop reports pertaining to this measurement need.

[http://www.netl.doe.gov/ssl/PDFs/DOE\\_SSL\\_Workshop\\_Report\\_Feb2005.pdf](http://www.netl.doe.gov/ssl/PDFs/DOE_SSL_Workshop_Report_Feb2005.pdf)

<http://www.netl.doe.gov/ssl/PDFs/SSLWorkshopReport.pdf>

## MN Authentication Summary

### Exhibit 3

#### **Basis for Authentication**

##### *Published Technology Roadmap:*

An updated Technology Roadmap has been published “Light Emitting Diodes (LEDs) for

General Illumination,” an OIDA Technology Roadmap Update 2002. October 2002. The report was sponsored by Optoelectronics Industry Development Association (OIDA), National Electrical Manufacturers Association (NEMA), Department of Energy – Office of Building Technology, State and Community Programs.

The purpose of this volume is an update to the OIDA technology roadmap on Light Emitting Diodes (LEDs) for General Illumination, issued in March 2001. The original roadmap, produced in collaboration with the Department of Energy (DOE-BTS), responded to a major opportunity to accelerate the development and commercialization of solid state light sources for general illumination. The new light sources offer savings in energy consumption, reduced pollution, substantial savings to the consumers, and the creation of a new lighting industry. – Specific quotations relevant to this measurement need are attached along with a list of participants in developing the roadmap.

[http://lighting.sandia.gov/lightingdocs/OIDA\\_SSL\\_LED\\_Roadmap\\_Full.pdf](http://lighting.sandia.gov/lightingdocs/OIDA_SSL_LED_Roadmap_Full.pdf)

## MN Authentication Summary

### Exhibit 4

#### Basis for Authentication

##### *Industrial Representative:*

Two letters have been obtained from groups that represent a large fraction of the solid state lighting industry. The first is the **Next Generation Lighting Industry Alliance (NGLIA)**. The NGLIA was formed in 2003 to foster industry-government partnership to accelerate the technical foundation, and ultimate commercialization, of solid state lighting systems. The Alliance was designated in 2005 as the “industry partner” by the U.S. Department of Energy for its Solid State Lighting program. The NGLIA is made up of 3M Company, Corning Inc., CREE Inc., Dow Corning Corporation, Eastman Kodak Company, General Electric Company, GELcore LLC, Lumileds Lighting, OSRAM Opto Semiconductors Inc., and Philips Electronics North America Corporation.

The person signing the letter is Dr. David Strip, who is the Chairman of the NGLIA. He states, “The NGLIA recognizes a critical need for advances in vision science, especially in color vision, in order to develop appropriate standards and measurement techniques that will be essential to the entry of solid-state lighting devices to the marketplace.”

The second letter is from the NEMA Solid State Lighting Section (NEMA SSLS). The Solid State Lighting Section promotes the understanding, implementation, and adoption of semiconductor light sources in specialty and general lighting systems. The Section will continue to evaluate new technologies and adopt those that fall within the category of solid state lighting.

The Solid State Lighting Section is tasked with integrating solid state light sources in existing lighting practices and the creation of new practices to fully exploit the technologies’ potential. Therefore, the Solid State Lighting Section will include all related downstream use including applications, control, and power necessary for effective use of solid state light sources. This also includes building and maintaining a center of expertise, creating definitions of terms, and coordinating activities with the sections of the NEMA Lighting Systems Division, of other portions of NEMA, and of recognized policy and standards setting organizations.

The second letter is signed by Bill Kennedy who is the Vice Chairperson of the NEMA SSLS.

He states, “The NEMA SSLS confirms that there is urgent need in the SSL industry for more accurate metrics for color rendering covering a variety of LED technologies. The importance in further establishing such quantitative metrics to/for the SSL industry as it goes about its activities in research, standards development, product design, production, and testing, is quite essential for all Solid-State Lighting work, including existing Industry and Government initiatives.” Copies of the letters are attached.

## MN Authentication Summary

### Exhibit 5

#### **Basis for Authentication**

##### *Individual Point of View:*

Two letters have been obtained from two company representatives that represent a large fraction of the LED manufacturers and the developers of solid state lighting devices in the United States.

The first letter is from M. George Craford, the Chief Technology Officer, from Lumileds Lighting, LLC a joint venture of Agilent Technologies and Philips Lighting, located in San Jose, California.

Craford's research has mainly focused on the development of visible light emitting diodes using a variety of compound-semiconductor materials. At Monsanto his group developed nitrogendoped GaAsP technology and, at Hewlett Packard, pioneered the development of AlInGaP LED's, and also developed AlGaAs and InGaN products. Craford is a member of the National Academy of Engineering and a Fellow of the IEEE. He has been honored with awards from various groups including IEEE, Optical Society of America, the Materials Research Society, and the Electrochemical Society.

He states, "The issue of color rendering, and what is an 'acceptable white' for illumination applications are both very poorly understood and very important. Better understanding and a method of standardization could have a major impact on the rate of adoption of LEDs for illumination applications. If we can understand and characterize what is truly needed for LED illumination we will be in a better position to make engineering trade offs in order to optimize the energy efficiency of LED illumination sources."

The second letter is from Dr. Kevin Dowling, Vice President of Strategy and Technology for Color Kinetics. Color Kinetics' lighting systems combine the many advantages of LEDs with advanced digital control technology – generating millions of colors, high-quality white light, and customizable effects without the cost and complexities of traditional lighting methods. More than a simple light source, Color Kinetics delivers complete system solutions that comprise versatile fixtures, controllers, authoring software, power/data supplies and accessories for wide-ranging applications. From Broadway sets and television studios, to renowned architectural structures, interiors, and artworks, Color Kinetics' customers break boundaries in their forward-looking use of light to transform spaces, build brands, and incite imagination.

He states, "Without an improved metric I fear that adoption of this energy saving technology and its many benefits will be adversely affected; it is that important to the lighting industry and the quality of light around us."

Copies of the letters are attached.